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United States Department of Agriculture,

BUREAU OF PLANT INDUSTRY,

Farmers' Cooperative Demonstration Work,

WASHINGTON, D. C.

THE CONTROL OF COTTON WILT AND ROOT-KNOT.

A SERIOUS PROBLEM.

General attention should be called to the spread of two diseases which seriously injure cotton, particularly on sandy land. These are cotton wilt, or "black-root," and root-knot. They already occur in scattered localities from North Carolina to Texas and are estimated to cause an annual loss exceeding \$2,000,000. There are thousands of acres of land already so infected that ordinary varieties of cotton can not be grown, and the area enlarges each year.

In addition to the loss of crops, this land has depreciated in market value; it costs more to cultivate on account of the weeds and grass that spring up after the cotton dies and the farmer must often use it for less profitable crops than cotton.

This situation is the more unfortunate because it is unnecessary. These diseases can be controlled by the means pointed out in this circular.

HOW TO RECOGNIZE COTTON WILT.

When plants wilt suddenly or the leaves yellow and fall without apparent reason, the wilt is to be suspected. If then a freshly wilted plant be pulled and the inner wood of the stem or root is found blackened, the disease is certainly wilt.

The trouble begins in May and June and continues to develop throughout the season. Its first appearance in a field is likely to be in small spots, which enlarge each season until large areas are affected. Beyond the spaces where the cotton is killed, dwarfed or stunted plants occur. Some plants remain alive in the worst areas, and by selection from such individuals resistant varieties have been developed.

HOW TO RECOGNIZE ROOT-KNOT.

Where root-knot occurs with wilt the injury from the latter is greatly increased. Root-knot itself does not show on the above-ground parts of the plant except through its indirect injury, and hence is frequently overlooked.

Root-knot causes enlargement of the roots, varying in size from a pinhead to a hen's egg. The galls on cotton are small, on okra

larger, and on cucumbers and tomatoes frequently of great size. Cowpeas are very subject to the root-knot, and experience has shown that when a farmer has observed that his cotton wilts worse after a pea crop the cause is root-knot.

It is desirable that the farmer know with certainty whether there is root-knot in his land. As a test, okra, tomatoes, or cantaloupes may be planted and the roots dug up about September 1 and examined for swellings or galls. If these are found, a rotation of plants immune to root-knot should be started to get rid of the pest.

IMPORTANT FACTS CONCERNING WILT AND ROOT-KNOT.

Cause.—Wilt is caused by a parasitic fungus, a minute thread-like organism, which enters the roots from the soil and plugs the water-carrying vessels of root and stem.

Root-knot is caused by tiny eelworms, or nematodes, which bore into the root. The irritation caused by these worms results in an enlarged growth of the part attacked.

Plants attacked.—The cotton-wilt fungus attacks only cotton and okra. There are very similar wilt diseases of cowpea, melon, tomato, and other crops, but they are not communicable to cotton.

The root-knot nematode attacks a very large number of plants and spreads freely from one to another. A few plants are immune; see list on page 3.

Duration of infection.—The wilt fungus lives many years in the soil. Rotation of crops affords only slight relief. The root-knot nematode may be starved out by rotations of crops on which it does not live.

Fertilizer and fungicide ineffective.—Neither cotton wilt nor root-knot can be prevented by the use of kainit, salt, phosphate, or other fertilizers, nor by sulphur, lime, or other fungicides applied to the soil. Stable manure in some cases affords a degree of temporary relief from wilt.

Relation to soil.—Both wilt and root-knot are mainly confined to sandy or light loam soils. Clay soils are but seldom infected.

Varietal resistance.—Varieties of cotton resistant to wilt have been developed. The only successful method of control lies along this line. Resistance to root-knot may be secured by future breeding, but at present this disease must be controlled by proper rotations.

Wilt and root-knot generally occur together. Most cases of "black-root" consist of such mixed infections and require a rotation to be practiced before resistant varieties will give their best results.

Manner of spread.—Wilt is spread by direct growth through the soil, by drainage water, by cattle, by manure, and in other ways not always explainable. No attempt to check it has ever succeeded. Root-knot is generally brought to a farm on figs, peaches, or other plants purchased, and, after its introduction, is spread chiefly through ordinary cowpeas, which are quite susceptible.

GOOD CROP ROTATIONS.

The principles on which rotation for root-knot are based are to use crops immune against attack and as far as possible those which return a profit, build up the fertility of the soil, and keep down weeds subject to root-knot.

Crops to use.

Corn.
 Winter oats.
 Rye.
 Wheat.
 Crab-grass.
 Iron cowpea.
 Brabham cowpea.
 Velvet bean.
 Peanut.
 Beggarweed.

Crops to avoid.

All cowpeas (except Iron and Brabham).
 Tomatoes.
 Okra.
 Cucumbers.
 Cantaloupe.
 Watermelon.
 Celery.
 Alfalfa.
 Vetch.
 Soy bean.
 Clover.
 Beans.
 Sugar cane.
 Sweet potato.
 Tobacco.
 Peaches.
 Figs.
 Mulberries.

The following treatment is suggested: Beginning in the fall, sow winter oats. These may be cut for hay in May or allowed to ripen. Follow the oats with Iron cowpeas sown broadcast, or better, in drills, where they can be cultivated once or twice. Cut these peas for hay, and plow the land at once for another crop of winter grain. This may be succeeded by corn, with Iron cowpeas or peanuts between the rows. The third year a wilt-resistant variety of cotton may be planted.

Wheat or rye may be substituted for oats and the velvet bean for the Iron cowpea, especially in the more southern districts.

Two varieties of resistant Upland cotton have already been developed by the Department of Agriculture. The Dillon is a limbless variety derived by selection from Jackson Limbless, which it excels in wilt resistance, uniformity, and productiveness. The Dixie is somewhat of the Peterkin type, with medium bolls and excellent productiveness. The Dillon has been distributed for several years and a considerable supply of seed is available from growers whose addresses can be learned from the agents of this office. The supply of the Dixie cotton is much more limited, but a movement has been started to provide for growing it on a larger scale by farmers in every county who are cooperating with the Department of Agriculture, with the South Carolina Agricultural Experiment Station, and with the Georgia State Board of Entomology in maintaining the purity of the strain and endeavoring to improve it by further selection.

HOW TO MAINTAIN PURE STOCKS WHEN SECURED.

The new varieties of cotton just mentioned maintain their resistant quality well if protected from mixture with other varieties. Deterioration results from three causes: (1) A small amount of reversion; (2) a crossing with other varieties in adjacent fields through pollen carried by bees; and (3) through mixture of seed at public gins. The last is the most serious.

Every means should be taken to have one's planting seed ginned separately and the gins thoroughly cleaned before starting. This

means the taking out of the roll and the careful sweeping of the floor around the gin, so that not a single seed shall be left. The use of gins having a seed-ejecting device is to be discouraged, as it is almost impossible to clean them thoroughly.

To avoid the bad effects of variation and cross-pollination, the following simple method has been found most effective.

Each fall select 25 to 50 of the best plants in the field; pick and save the seed separately. The following year plant this seed in parallel rows, keeping each lot separate and planting at least 100 hills from each parent plant. The crop from these progeny rows will show marked differences. The yield from each row should be determined by weighing, and the most productive and disease resistant saved for planting an "increase" plat, on which enough seed can be grown for planting the entire crop the following year. This method of breeding from individual plants is the basis of all success in the improvement of crops.

The question arises, Can not the farmer who has a variety he prefers to grow develop a strain resistant to wilt by selecting from diseased spots in the field individual plants which are resistant and planting the seed from these? Also, In cases where farmers are unable to secure seed of the resistant varieties distributed by the Department of Agriculture, should they not be advised to make their own selections? The experience of 10 years has convinced us that these questions are to be answered in the negative. The farmer will do better to start with a resistant strain already developed and confine his attention to the maintenance of its resistance. The time required to develop a resistant variety of cotton and the amount of careful work involved make it a task only for experiment station workers or trained seed breeders to undertake.

The Dillon and Dixie varieties are too late in maturing to be recommended for the boll-weevil territory and should not be planted there except on an experimental scale. The Department of Agriculture is at present engaged in the breeding of additional wilt-resistant strains of cotton which shall be early enough to be suited for use under boll-weevil conditions.

The supply of wilt-resistant cotton and cowpeas is at present not sufficient to meet the demand. The Bureau of Plant Industry has entered into cooperation with the South Carolina Agricultural Experiment Station and with the Georgia State Board of Entomology to encourage an increased production and dissemination of these varieties, and desires to bring to the attention of progressive farmers the opportunity now presented of developing a profitable business in growing them for sale. Farmers resident in South Carolina who are interested and who desire further information should write to the South Carolina Agricultural Experiment Station, Clemson College, S. C. Residents of Georgia should address the State Board of Entomology, Atlanta, Ga.

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Approved:

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Acting Chief of Bureau.

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